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REMOVAL SUPPORT TEAM 3
EPA CONTRACT EP-S2-14-01

June 17, 2018

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**SUBJECT: PUERTO RICO LANDFILL CAPACITY ASSESSMENT – HURRICANE
MARIA RESPONSE – YAUCO LANDFILL CAPACITY ASSESSMENT
STUDY AT YAUCO, PUERTO RICO**

Dear Mr. PLÖSSL,

Enclosed please find the capacity assessment study for Yauco Landfill according to the information obtained during April 30th, 2018 reconnaissance at the site, and the information provided by owners, consultants, Puerto Rico Environmental Quality Board, and municipality representatives. If you have any questions or comments, please do not hesitate to contact me at (787) 602-8424.

Sincerely,

WESTON SOLUTIONS, INC.

Hector Rodríguez-Cesani, MS, PE
RST 3 Site Project Manager

an employee-owned company



In association with Scientific and Environmental Associates, Inc.,
Environmental Compliance Consultants, Inc., Avatar Environmental, LLC,
On-Site Environmental, Inc., and Sovereign Consulting, Inc.

Hurricane Maria Emergency Response
Yauco Landfill Capacity Assessment
Yauco, Puerto Rico

Prepared for:

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ACRONYMS

Name	Acronym
Area of Concern	AOC
Above Mean Seal Level	AMSL
Combustible gas indicator	CGI
Construction and demolition debris	C&D
Department of Natural and Environmental Resources	NERD
Environmental Protection Agency	EPA
Federal Emergency Management Agency	FEMA
Fish and Wildlife Services	FWS
Flood Insurance Rate Map	FIRM
General "Dotacional "	DT-G
Geographic information system	GIS
Hazardous Waste Operations and Emergency Response	HAZWOPER
Health and Safety Plan	HASP
Hydrogeologic Unit Code	HUC
Immediately dangerous to life or health	IDLH
Mean Sea Level	MSL
Municipal Solid Waste	MSW
Municipal Solid Waste Disposal Facilities	MSWDF
North Coast Limestone Aquifer System	NCLAS
National Flood Insurance Program	NFPI
National Oceanic and Atmospheric Administration	NOAA
Occupational Safety and Health Administration	OSHA
Operations and Maintenance Manual	O&M
Photoionizing detector	PID
Puerto Rico Aqueducts and Sewers Authority	PRASA
Puerto Rico Electric Power Authority	PREPA
Puerto Rico Environmental Quality Board	EQB
Puerto Rico Planning Board	PRPB
Puerto Rico Solid Waste Management Authority	PRSWMA
Resources Conservation	RC

Name	Acronym
Resource Conservation Recovery Act	RCRA
Solid Waste Disposal Facilities	SWDF
Spill Prevention, Control and Countermeasure	SPCC
Stormwater Pollution Prevention Plan	SWPPP
U.S. Geological Survey	USGS
Underground Storage Tank	UST
United States Army Corp of Engineers	USACE
United States Fish and Wildlife Service	USFWS
Wastewater Treatment Plant	WWTP
Water Treatment Plant	WTP

UNIT CONVERSION

International System (SI)	Multiply by	Universal System (SU)
kilometers (km)	0.6124	miles (mi)
meters (m)	3.2808	feet (ft)
centimeter (cm)	0.3937	inch (in)
millimeter (mm)	0.0393701	inch (in)
square meter (m ²)	10.7639	square feet (ft ²)
acres (ac.)	3930.3957	square meter (m ²)
acres (ac.)	1.0296	acres (ac.)
Celsius (°C)	1.8 * (°C+32)	Fahrenheit (°F)
Megagrams (Mg)	2204.62	pounds (lb)
kilograms (kg)	0.0011	US Tons
grams (g)	0.0022	pounds (lb)
mg/kg	1	part per million (ppm)
tons per cubic meter (tons / m ³)	1.686	pounds per cubic yard (lb/yd ³)
kilowatts (kW)	1.341	horse power (hp)
Megavolt (meV)	1.6018 x 10 ⁻¹³	Joules
day	24	hours (hr)
years	365	days

INTRODUCTION

At the request of the Puerto Rico Environmental Quality Board (EQB), the Landfill Assessment Project includes the evaluation of the 29 Municipal Solid Waste Landfills (MSWLF) operating in Puerto Rico. To accomplish this, the Federal Emergency Management Agency (FEMA) tasked the Environmental Protection Agency (EPA), which contracted Weston Solutions, Inc., Removal Support Team 3 (RST 3), to provide technical, logistical, and administrative assistance for the assessment starting on March 31, 2018. This request is part of the Technical Direction Document Number TO-0010-0160, under contract number EP-S2-14-01. The project establishes an unprecedented recompilation of data regarding the operation and the remaining operational capacity of all the facilities up until 2018.

This report is a combination of many individual efforts to provide an informative assessment of the sanitary landfills and the uncontrolled land disposal facilities (open dump sites) throughout Puerto Rico, due to the increased debris generated by Hurricane Irma and Maria in August and September 2017, respectively. This document provides an evaluation of the remaining capacity available at the visited landfills, to serve as a valuable reference to those responsible for the challenging task of designing, constructing, operating, or closing a facility in compliance with applicable federal and local requirements. To determine the capacity of the landfills, this report, where available, collates information on the active cells, cells waiting for a permit, cells under construction, and planned cells. When addressing the capacity of the MSWLF, this report examines the level of compliance of the sites, in comparison with the criteria established by the assessment team, which considers the slope stability, top deck characteristic, operational condition, engineering controls, operational and management strategy, and any significant expansion after 2004. Within the evaluation of the MSWLF, it is also determined whether any significant update can be made to the existing 2004 Malcolm Pirnie report. The information gathered on location restrictions and other risk factors are reported in relation to the environmental sensitivity of each location and is expanded upon throughout this report.

The assessment team conducted the evaluation of the MSWLF in two phases: Phase I consisted of determining schedule and criteria, site reconnaissance, surveying of some pre-determined landfills,

and initial evaluation of the remaining capacity of the landfills. The results of the Phase I activities, including site mapping, reconnaissance checklists, rankings, initial capacity estimates, site photographs, environmental sensitivity, and geology for the 29 landfills was summarized in the *Draft Interim PR Landfill Capacity Assessment Report (May 2018)*. Phase II included the re-visit of some of the MSWLF to ensure the quality of the information gathered, and the review and expansion of the drafts reports submitted in Phase I.

In addition to the Phase I and Phase II activities, the assessment team has developed two Master Spreadsheets included in the reports package, together with the supporting documentation. The Master Workbook includes all the calculations and assumptions used to determine the remaining capacity of the 29 facilities. The Landfill Assessment Master Table includes a comparison between the information gathered from the EQB, the 2004 Malcolm Pirnie reports, and the results obtained for this report. The matrix discussed in the Site Evaluation section of this report is included as part of the Landfill Assessment Master Table.

The Landfill Capacity Assessment Report consists of an Introduction and eight Chapters. The Introduction provides the reader an overview of the project and introduces the sections and information included in the report. The General Site Description (Chapter 1) includes the Geographical Site Location and the Environmental Evaluation of the MSWLF. The Geographical Site Location describes the site location areas, climate, demographics, topographic features, geomorphology, soil types and classification, and the hydrology. The Environmental Evaluation section describes the environmental sensitivity and natural systems, flood plains, and infrastructure available within or close to the landfill property.

Chapter 2 describes the physical and operational aspects of the facility along with the description of equipment, engineering controls, and waste type received in the landfill. It also includes, a Site Evaluation section that reviews all the findings according to the site reconnaissance, the documents gathered, and the investigation performed as part of the mission. Chapter 3 presents the surveying and landfill historical changes and describes the methods used to create the figures and develop the observations of this assessment in terms of expansion and slopes ratios.

Chapter 4 presents all the assumptions and the calculations of the lifespan of the landfill. The report also includes chapters that describe and discuss the Hydrogeological Risk Factors (Chapter 5), present the Conclusions of the assessment (Chapter 6), and give some Recommendations for future

expansion of the presented information (Chapter 7). Chapter 8 lists the references used for compiling the report.

Chapter 1

GENERAL SITE DESCRIPTION

1.1 Geographical Site Location

The assessment for Yauco Municipal Solid Waste Landfill (MSWLF) has been developed according to the site visit and the available relevant data obtained from different sources such as EQB, municipalities, and external consultants. In order to obtain the necessary information for the project objectives within the established timeframe, the following information was considered: technical specification and designs, climate, topography, geology, groundwater monitoring system, source of potable water, environmental conditions, and safety protocols. The site visit included the observation of the landfill operational logistic, management, engineering controls, and potential or present hazardous conditions.

1.1.1 Site Location

Yauco MSWLF is situated at State Road PR-335, kilometer (km) 3.8, at Barinas Ward, Yauco. According to “Geolocalizador” from Puerto Rico Planning Board (PRPB), the Yauco Landfill is in land registry number 408-000-001-02 that consists of 611 acres (ac.) (2,474,292 m²) of total property. According to the Yauco MSWLF, the property area is 67.9 ac. (275,128 m²) and the disposal area is 58.2 ac. (235,824 m²). The Yauco Landfill is in the south region of the island of Puerto Rico, 30.4 km (18.9 miles) west of the Mercedita Airport in Ponce. The closest residential building is 617.4 meters (m) west of the landfill. The nearest tranquility areas include the Hospital Bella Vista, located 3.2 km (2 miles) north of the landfill. The closest school is about 1 km (0.65 miles) west of the landfill. Location and coordinates of the landfill are summarized in Table 1-1.

Table 1-1. Site Location.

<i>Site</i>	<i>Address</i>	<i>Property Area</i>	<i>Disposal area</i>	<i>Latitude/Longitude</i>
Yauco Landfill	PR-335 Barinas Ward,	275,128 m ²	235,824 m ²	17.9982 N
		67.9 acres	58.2 acres	66.8635 W

1.1.2 Climate

Yauco has a tropical climate with an average annual temperature of 26.1°C (78.9°F) and 904 mm (35.5 in) average annual rainfall. The month with the least precipitation is January, with 26 mm (1 in) of rainfall. The month with the most precipitation is October, with an average of 140 mm (5.5 in) of rainfall. The warmest month of the year is August, with an average temperature of 27.4 °C (81.3°F). January has the lowest average temperature of the year with an average of 24.3°C (75.7°F). A 15 % of settlement factor of landfill materials is assumed based on the amount of precipitation received at the site.

The United States Geological Survey (USGS) has ranked the U.S. coastal areas into areas with the number of hurricanes expected to occur during a 100-year period based on historical data, Puerto Rico is classified as the most extreme category of risk, with more than 60 hurricanes per 100 years.

1.1.3 Demographics

At the time of the assessment, the Yauco Landfill was not receiving solid waste from any municipality. According to the US Census of 2010, the population of the municipality of Yauco was of 42,043 inhabitants. The Barinas Ward population is 5,930 inhabitants.

1.1.4 Topographic features

The Yauco MSWLF is located at smooth rolling hills with elevations from 110 m to 135 m above mean sea level (AMSL).

1.1.5 General Lithology

According to the USGS Geologic Map of the Yauco and Punta Verraco Quadrangles, Puerto Rico, the Yauco MSWLF is composed of Mudstone and basal conglomerate member (Tjd) and Limestone member (Tjl), both of the Juana Díaz Formation, and Alluvium (Qa).

The Mudstone and basal conglomerate member (Tjd) constitute the main portion of the landfill. It is composed of gray to grayish orange mudstone and sandstone, and lenticular sand and gravel deposits. It has an exposed thickness of approximately 50 to 130 m.

The Limestone member (Tj1) consists of thin to thick bedded and massive reef limestone, grayish orange to very pale orange in color. Some limestone beds are fossiliferous, mainly composed of corals and algal plates with exposed thickness approximately between 80 to 350 m.

1.1.6 *Geomorphology*

The landfill area is characterized by rolling terrain with moderate to steep slopes. Several dendritic patterns are identified for some drainage features near the site. The nearest water body is the Yauco River, located east of the landfill. In general, the area has several fault zones, intrusions features, and different weathering grade

1.1.7 *Soil Types and Classification*

Based on the Natural Resources Conservation Service (NRCS) Report for San Germán Area, Southwestern Puerto Rico, the Yauco Landfill is composed of 20.3% of Costa Pitahaya (CuF). Costa usually has slopes from 20 to 60% and elevations between 80 to 570 feet (ft). The mean annual precipitation is about 16 to 50 in with mean annual air temperature ranging from 70°F to 88°F with no frost period. This soil type is mainly found in ridges, hillslopes. These soils are not prime farm land and soil profiles typically include: Very gravelly clay loam, A found between 0 to 7 in bgs; gravelly clay, Ac found between 7 to 11 in bgs; silty clay, C found between 11 to 19 in bgs, weathered bedrock, Cr found between 19 to 43 in bgs; and unweathered bedrock, R found between 43 to 63 in bgs. The natural drainage class is well drained. This classification represents soils that are well drained with a moderately low to moderately high (0.14 to 1.42 in/hr) capacity of the most limiting layer to transmit water (Ksat) and a depth to water table of more than 80 in bgs. They also present no frequency of flooding and/or ponding, very low (1.5 in) available water storage in profile, a land capability classification (nonirrigated) of 7c, and a hydrologic soil group D.

Pitahaya soil usually has slopes from 20 to 60%. This soil type is mainly found in ridges, hillslopes. These soils are not prime farm land and soil profiles typically include: gravelly clay loam, Ap found between 0 to 2 in bgs; gravelly clay, AC found between 2 to 11 in bgs; weathered bedrock, Cr found between 11 to 27 in bgs and unweathered bedrock, R found between 27 to 80 in bgs. The natural drainage class is well drained. This classification represents soils that are well drained with a moderately low to moderately high (0.14 to 1.42 in/hr) capacity of the most limiting layer to

transmit water (Ksat) and a depth to water table of more than 80 in. They also present no frequency of flooding and/or ponding, very low (0.9 in) available water storage in profile, a land capability classification (nonirrigated) of 7c, and a hydrologic soil group D.

Other soil compositions at the site are: 0.1% of El Papayogravelly clay loam (EpF), 2.7% of Guayacan clay (GyC), 47.6% of Landfill (LfC), 1.6% of Melones clay (MnC), and 27.7% of Pithaya – Limestone outcrop-Seboruco complex (PsF) (Natural Resources Conservation Services, 2018).

The Puerto Rico Planning Board (PRPB) started a project that requires the municipalities to create specific maps that delineate the different zones, limits, and uses to help in the planning and development of lands in Puerto Rico. These categories are the instrument to designate land use within the boundaries of each municipality. According to the land use plan for Yauco, the landfill site location is classified as Common Rustic Soil (SRC) and Vial (VIAL).

1.1.8 Hydrology

The site is located 4.6 km (2.86 miles) north of the Caribbean Sea. The landfill facility is located between two principal streams of the area. The Loco River is 2.0 km (1.24 miles) west of the landfill and directs the flow towards the coastal barrier to the Caribbean Sea. The Yauco River is at 2.5 km (1.55 miles) east of the landfill and directs the flow towards the coastal barrier to the Caribbean Sea. See Appendix L.

The EQB and the Puerto Rico Aqueduct and Sewer Authority (PRASA) do not have potable wells around the landfill. The nearest USGS wells are four wells located 3.8 km (2.36 miles) to northeast of the landfill.

The Yauco MSWLF is upstream of freshwater, emergent wetland, and fissured aquifer. The facility is located above a minor aquifer which is composed of volcanoclastic, igneous, and sedimentary rocks. The main aquifer near the landfill is located in the Rio Yauco Valley. This aquifer is an alluvial aquifer which is recharged directly by the Yauco River.

1.2 Environmental Evaluation

The Yauco MSWLF environmental conditions were determined according to the research performed by the assessment team and data obtained from available maps, literature, and a site visit. The description area for the environmental evaluation in this report is based on the Regulation for the Evaluation and Processing of Environmental Documents of the EQB (November 30, 2010). Based on the regulation and using a safety factor of 60 m distance, a radius of 690 m was established for the description of environmental sensitivity. Because the landfill area was larger than the established 460 m, an additional 230 m radius was added to cover the entire perimeter of the landfill.

1.2.1 *Environmental and Natural Systems*

According to the Environmental Sensitivity Index (ESI) Maps published by the National Oceanic and Atmospheric Administration (NOAA) and used by the United States Fish and Wildlife Services (USFWS), the Yauco MSWLF is located at an environmentally sensitive area. The property is located within an area inhabited by a species of bird, Puerto Rico Nightjar. These birds are medium-sized nocturnal or crepuscular birds, characterized by long wings, short legs and very short bills. During the reconnaissance, personnel observed Ardeidae, a species of bird also known as herons.

The Puerto Rican Nightjar lives adjacent to the northern part of the property. The Natural Reserve Bosque Seco de Guánica is located around 0.6 km (0.37 miles) south of the landfill. This reserve preserves flora and fauna distinctive from the dry forest. The fauna includes 185 birds, some of which are endangered species (Arendt, Faaborg, Canals, & Bauer, 2015). *Ottoschulzia rhodoxylon* (federally endangered plant), *Trichilla triacantha* (federally endangered plant), and the Puerto Rican Crested toad (*Peltophryne lemur*) (federally threatened species) have been identified by the U.S. Fish and Wildlife Service as proximate to the Yauco MSWLF. The close proximity to the landfill may affect the life of these species. More investigation is needed to know the impact of the landfill to these species.

The Yauco MSWLF is surrounded by the Karst Restricted Special Planning Area (APE-RC, by its acronym in Spanish) (Planning Board, 2014). These Karst areas are an important region of recharge for the existent aquifers.

1.2.2 *Flood Plains*

According to the Federal Emergency Management Agency (FEMA) and the Flood Insurance Rate Map (FIRM) number 72000C Panel 1615H, revised on April 19, 2005, the Yauco MSWLF floodplain classification is Zone X. This classification represents areas determined to be outside the 0.2% annual chance floodplain. This information is consistent with the FEMA and the FIRM number 72000C Panel 1980J, revised on April 13, 2018.

1.2.3 *Infrastructure*

No information was recovered for water distribution of the Yauco MSWLF. According to the assessment before Hurricane Maria, Puerto Rico Electric Power Authority (PREPA) was in use in to power the facilities. The closest Potable Water Treatment Plants (WTP) is located 5.3 km (3.29 miles) to the north of the site. The Waste Water Treatment Plant (WWTP) is approximately 3.12 km (1.94 miles) to the northeast of the site.

Currently the Yauco MSWLF is not operating due to legal disputes.

2.1 Disposition Areas and Process

Based on site reconnaissance visit and interview with the managers of Eco Park, the assessment team was able to acquire information regarding staffing, equipment, site access controls, waste placement, and material recovery.

2.1.1 Employees, Equipment and Operational Features

The Yauco Landfill had no employees and no equipment by the time of our visit. The landfill has been operated by the municipality since February 2018. The municipality had a contract that designated LandTech as the landfill operator from 2014 through February 2018. At the end of January 2018, LandTech believed the Yauco Landfill had reached capacity and that waste could not be safely placed under current conditions. EQB reported that, based on an April 2018 inspection, Yauco Landfill is still accepting small quantities of construction and demolition debris (C&D) debris and placing it into the landfill.

Prior to the Municipality reportedly ceasing operations at the landfill, the primary responsibility of the staff at the landfill was the placement and compaction of Municipal Solid Waste (MSW). Daily placement and compaction was accomplished using a push and cover technique. This was typically accomplished with the use of a dozer. Daily cover consisted of native soils which are excavated onsite.

Maintenance and repairs of equipment were performed in a maintenance and storage area in the landfill. A 5,000-gallon (gal) fuel storage tank and a 3,000-gal used oil storage tank are located on the landfill property.

2.1.2 Distribution of Landfill Area

The Yauco MSWLF is at the center of the property and is approximately 30 ac. Extraction areas are located at the north and east area of the landfill.

Puerto Rico's general recycling rate is below 7% of the total generated waste. Recycling, composting, or waste separation was not reported at this site, and people are not allowed to scavenge materials from the landfill. No material recovery programs have been implemented at the landfill to control waste volume and placement. However, the municipality has had an ADS-approved recycling program since September 2015. Before the hurricane the program was known to serve 5,247 households and have a 16.3% average participation rate.

2.1.3 *Waste Type*

The Yauco MSWLF accepted non-hazardous waste from Yauco, Santa Isabel, Maricao, Sabana Grande, and Villalba when it was in operation. Currently, the landfill does not receive solid waste from any municipality.

The waste received (Pre-Hurricane Maria) during normal conditions consisted of household MSW (70%) and others commercial wastes (30%). The disposal waste rate for Yauco was not available at the time of the visit. The quantification method of waste stream used was a scale house.

The landfill was also receiving and treating industrial wastewater in two solidification pits since at least 2002. LM Waste constructed the solidification pits in 2001. The industrial wastewater would be mixed with dirt, fly ash, or bottom ash (EQB approval for ash use in 2005) and placed into the landfill. After Maria, the solidification pits' concrete was in good condition, however, the metal structure covering the pits was damaged. The current status of the solidification pits is unknown.

2.1.4 *Engineering Controls*

Site access is controlled with a perimeter fence and a no guard entrance gate. Some traffic control and disposal signs were observed during the site visit. The Yauco MSWLF has four retention ponds for stormwater. The landfill has no leachate collection system and does not have a gas collection control system (GCCS) in place. The Yauco MSWLF has five groundwater monitoring wells in place.

2.2 Site Evaluation

To accomplish the assessment evaluation and expand the recommendations for future investigation, the team assessments were based on the use of a simplified version of a Leopold's matrix with a checklist, and a pre-established criterion within the interest of agencies such as EPA, USFWS, and the United States Army Corps of Engineers (USACE). The matrix criteria presented in Table 2-1 initially was evaluated in a Yes or No questions divided into categories and criteria used to evaluate the landfills, and includes permits, engineering controls, environmental sensitivity, and the determination criteria. A second version of the matrix expand the criteria and questions into more detailed answers for some of the criteria. The matrix is submitted as part of the supporting material for the 29 reports.

Table 2-1. Evaluated Criteria.

Permits	Title V, Operational Permit, SWPPP, SPCC Plan, Closure Plan, Expansion Plans, Under EPA order or Agreement, Type of Landfill, Owner/Operator/Consultant
Engineering Controls	GCCS, Gas levels, SWPPP Controls, SPCC Controls, Liner, Leachate Collection System, Monitoring Groundwater, Trained Personnel, MOLO Certification.
Environmental Sensitivity	Environmental Sensitivity Area, Aesthetics Impacts, Potential Impact to Migratory Birds, Area of Potential Effect to Archaeological Resources, Potential Impacts to Drinking Water Supplies, Potential Impacts to Endangered Species, History of Landfill Fire, Residences inside a 100 m radius.
Determination Criteria	Slopes steeper than 2.5H:1V, Expansion area after 2004.

Due to the Emergency Response Protocol, and potentially hazardous conditions within the landfill to the teams working the assessments during site reconnaissance, a MultiRAE was required. Properly calibrated equipment was used during the site visit with the capacity of measuring CGI, used for monitoring oxygen (O₂), hydrogen sulfide (H₂S), dichlorine (Cl₂), carbon monoxide (CO), and volatile organic compounds (VOCs). The action levels were established as per specifications in the Health and Safety Plan (HASP) for Hurricane Maria Emergency Response for US Virgin Islands and Puerto Rico (DC No: RST3-4-D-0125). The action levels used for lower explosive limit (LEL) was greater than 10%. For O₂, less than 19.5% is considered as deficient, and above 23% is considered enriched. The permissible exposure limit (PEL) used for H₂S was 20 parts per million (ppm) and Immediately Dangerous to Life and Health (IDLH) was 100 ppm. The PEL used for Cl₂ was 1 ppm and IDLH was 10 ppm.

The Yauco MSWLF is operated professionally with engineering staff by Eco Park, an active EQB permit (IDF-16-0019), not under Title V regulations, not or under any consent decree or order with a Closure Plan. According to EQB data, the landfill has had lateral expansion since 2008.

The Yauco MSWLF is a pre-subtitle D of the Resource Conservation Recovery Act (RCRA) and has no gas to energy infrastructure or collection system. Field meters did not detect levels of gases above the action levels. The facility does not have any gas monitoring wells but does have a groundwater monitoring system that consists of five wells. The landfill has a Stormwater Pollution Prevention Plan (SWPPP) and a Spill Prevention, Control, and Countermeasure (SPCC) Plan, both with operational controls implemented. The landfill has a 5,000-gal fuel storage tank and a 3,000-gal used oil storage tank is located in the property.

The Yauco MSWLF has no liner system or leachate collection in the actual cell. There are plans for four future cells with liners, which are approved by the agencies. It is unknown whether on-site personnel are trained in the Waste Management Practices, the correct Personal Protective Equipment (PPE), or Manager of Landfill Operations (MOLO) Certification.

The facility is not in a fire susceptible area and has environmental sensitive areas with visual impact on the scenario. The location is surrounded by, but not within, the Karst area of PR under the Restricted Special Karst Zone Area (APE-RC, by its acronym in Spanish) as of the 2016 boundaries. However, its location may still present a possible impact to species, migratory birds, threatened or endangered species, and to the environment. Terrestrial cortex removal (cover soil

excavation) is performed at the landfill site. No archaeological site inside or in the surroundings of the facility perimeters were identified during the literature research (See Appendix F). However, according to the document of Preliminary Archaeological Identification prepared as a sector collaboration work for the NCR Environmental Working Group: Landfill Subgroup and included in the supporting material for the Landfill Assessment Report, the Yauco MSWLF is classified under a low archaeological sensitivity. Low classifications designate areas that are not within a known sensitive archaeological area or within/adjacent to an area previously subject to archaeological studies with negative results. No residential buildings were identified within 100 m from the footprint of the landfill (See Appendix G).

The Yauco MSWDF does not receive solid waste from any municipality. According to State laws all municipalities are required to have a waste diversion plan. The recycling participation rate for Yauco was reportedly 16.3% before Hurricane Maria. Further and a more detailed analysis will be necessary to address and obtain the proper and accurate conclusions about the impact of Hurricane Maria on the lifespan of this landfill. At the time of the interview, landfill personnel do not know the amount of the incoming waste rate (tons per day) during the period after Hurricane Maria. The most noticeable impact of Hurricane Maria on the landfill lifespan is the increase of the amount of MSW and commercial waste. Before Hurricane Maria, the landfill did not receive any vegetative debris or industrial waste. Post-Hurricane Maria, an average of 70% of the incoming waste is MSW and 30% is commercial wastes. The daily cover consisted of native soils which are excavated onsite.

2.2.1 Slope Stability

On April 19, 2018, in a meeting held at the CEPD, it was determined by the assessment team that the slope of 2.5:1 (21.8 degrees) is the maximum allowable slope at landfills for slope stability purposes. Solid waste behaves in a manner that is quite similar to another fill material, which tends to slip when the slope angle is too steep. As landfills increase in size, the need to consider slope stability has become more critical due to unstable slopes threatening landfills to collapse.

Recent topography or other available data provided by the landfill administration was used to determine the landfill's angle of slope. If data was not available, then the assessment team divided the Area of Concern into quadrants following the geographical orientation towards North, South,

East, and West. At each quadrant, a range between two to six measurements were taken to obtain an average observed slope. Some of the methods used to determine the slope of the landfill consist of defining several randomly selected locations within the slope and measuring with a non-calibrated inclinometer. When possible, geographical location using a handheld GPS unit was recorded, obtaining latitude and longitude values and inclination degree.

At the Yauco MSWLF, a Topography Map from March 2018 was used to calculate the slopes of the landfill. The north side slope of the landfill ranged between 25° and 26°, with an average of 25°. The south side slope ranged between 24° to 26°, with an average of 25°. The east side slope ranged between 22° to 26°, with an average of 24°. The west side slope ranged between 25° to 27°, with an average of 26°. The slope angles at the Yauco MSWLF do not fulfill the slope stability criteria of 2.5:1 (21.8 degrees).

Chapter 3

SURVEYING AND LANDFILL HISTORICAL CHANGES

3.1 Historical Landfill Extension

A fundamental part of this assessment was to create several figures about the historical extension and the footprint delineation of the landfill area. The delineation of the landfill footprint extension was produced by chosen historical images from Google Earth from the 1990's and 2017. These images were combined in GIS to record significant visual changes over the years (See Figure H-1). This shows the approximate landfill footprint as compared with other sources such as Malcolm Pirnie reports and CAD drawings provided by landfills owners or operators. Figure H-2 shows the footprint delineation made by FS Surveying in 2003, Malcolm Pirnie reports in 2004, and our present footprint interpretation as per Google Earth imagery. After superimposing the three delineations in one georeferenced figure, it was possible to notice different landfill footprint delineation through time. However, something that caught our attention was the slightly different in the footprint interpretation between 2003 & 2004 which could be as lack of a standard method to determine and delineate the landfill footprint. In most of the cases has been possible to observe considerable changes up to present delineation interpretation made it in this assessment.

Chapter 4

CAPACITY

To determine the remaining capacity and lifespan of the landfills, information was gathered from multiple sources: original design criteria, information from the municipalities, LandGEM if applicable, the landfill permits, and from field notes taken during site visits. For sites that do not have all the relevant information, assumptions are noted in the table. The purpose of completing these calculations is to determine the current capacity status of the landfill, as part of the response efforts due to the impact from hurricanes Irma and Maria. Furthermore, the calculations will aid in determining the present capacity status for Puerto Rico's overall solid waste management. Further studies could be accomplished with an expanded mission timeframe to have a better waste stream characterization.

The current volume of waste disposed in the landfill was estimated by calculating the volume using a 10% to 15% settlement factor along with the designed annual waste acceptance rate (disposal rate). Due to the difference in climate conditions the 10% has been considered for dryer locations and 15% for more humid or rainy locations. A 15% settlement factor was assumed for the Yauco MSWLF.

The information presented in the Table 4-1 outlines the General Information, Initial Design Capacity, LandGEM data if available, Remaining Operational Life Calculations, and Planned Expansion.

4.1 Landfill General Information

The information in this section presents the general information about the landfill, including: name of the landfill, the owner/operator, year landfill opened, total permitted area (ac.), total landfill area (ac.), total permitted volume (m³), liner system, type of liner, cover material, percentage of daily cover, standard density of in-place waste and type of compaction.

The density of in-place waste being used for this report is 1,000 pounds per cubic yard (lbs/yd³) for poorly compacted waste, and 1,200 lbs/yd³ for well compacted waste. Generally, poorly

compacted waste is for landfills that have bulldozers that compact the waste, and do not have a piece of equipment designed for waste compaction.

Due to the age of some of the landfills, a liner system may not be present. These landfills were created prior to when the current regulations went into effect. There is a possibility the landfill has a combination of lined and unlined cells, with the newer cells having a liner system as well as a leachate detection system.

4.2 Initial Design Capacity Information

The information presented in this section is the design specifications and calculations. It presents the capacity of the landfill in Megagrams (Mg) and converted to tons using a conversion factor of 0.907185.

4.3 Actuals and LandGEM Information

The data in this Chapter was either collected from LandGEM, the managing municipality, or extrapolated from the latest professional survey.

4.4 Remaining Operational Life Calculations

The remaining operational life of the landfill was estimated using the equation 4-1, and the results are presented in Table 4-1.

$$Lifespan = (RC - Cover) \times \frac{Density}{Disposal} \quad 4-1$$

where:

Lifespan	=	presented in years,
RC	=	remaining capacity of the landfill,
Cover	=	volume of daily cover, which represents 10% of the total remaining capacity,
Density	=	compacted density of in place waste (For the Yauco Landfill, no compaction equipment was observed. No compaction equipment was observed on-site; therefore, a density factor of 1,000 lbs/yd ³ was used in the calculations.), and

Disposal = the rate of material disposal at the landfill.

4.5 Planned Expansions

The Yauco MSWLF is not operating due to legal disputes. Currently, there are plans for four future cells, which are approved by the agencies and have liners.

Table 4-1. General Information, Design Capacity of the Landfill (TeraTeck)

Remaining Capacity and Lifespan Calculations									
Landfill General Information									
Name:	Yauco Municipal Landfill								
Operator:	Municipality								
Year Initiated Operation:	1970								
Total Landfill Area	593		Acres						
Total Permitted Area	30		Acres						
Liner System		Liner		No liner		Combination			
Cover Material		Soil		Soil and Mulch Mix					
Percentage of Daily Cover		10 %							
Standard Density		1000 lb/cy		Poorly Compacted		Well Compacted			
Initial Design Capacity Information									
Existing Cell	Year Performed:	2014		Density Used:	1200 lb/cy				
	Maximum design capacity of landfill in Mg:	2172155		Converted to ton:	2408955				
	Maximum Design Waste Capacity in m ³ :	3051049							
	Maximum Design Capacity Using Standard Density in Mg:	1810129		Converted to ton:	2007463				
Planned Cell	Year Performed:	2015		Density Used:	1200 lb/cy				
	Maximum design capacity of landfill in Mg:	2990136		Converted to ton:	3316109				
	Maximum Design Waste Capacity in m ³ :	4200000							
	Maximum Design Capacity Using Standard Density in Mg:	2491780		Converted to ton:	2763424				
Actuals and LandGem Information (if available)									
LandGem Waste Design Capacity in Mg				Converted to m ³ :	0				
Landfill Closure Year, if known:									
Annual Waste Placement up to year		2017							
LandGem Sum of Annual Acceptance Rate up to year 2017									
Lifespan Calculations Using LandGem									
Remaining Capacity (Mg) Using LandGem Information		0		Converted to m ³ :	0				
Average Annual Waste Acceptance (Mg/yr) to Closure				Mg using 10% settlement	0				
Lifespan Using LandGem Data:	N/A	Yrs.		Lifespan including standard value of settlement:	N/A	Yrs.			
Remaining Capacity Using Initial Design Capacity and Standard Density									
Maximum Design Capacity Using Standard Density in Mg		1810129		Remaining capacity in yd3	0	yd3			
Average Annual Waste Acceptance (Mg/yr) to Closure		26990		Remaining Capacity in tons	0	tons			
Sum of Annual Acceptance Rate up to year 2017 in Mg		1810129		Remaining Capacity in m ³	0	m ³			
Remaining Capacity Using Initial Design Capacity in Mg		0		Mg with 10% settlement	0				
Lifespan using Design Capacity as of 12/31/2017	0	Yrs.		Lifespan including standard value of settlement:	0	Yrs.			
Planned Remaining Capacity Using Initial Design Capacity and Standard Density									
Maximum Design Capacity Using Standard Density in Mg		2172155		Remaining capacity in yd3	4788056	yd3			
Average Annual Waste Acceptance (Mg/yr) to Closure		66584		Remaining Capacity in tons	2410440	tons			
Sum of Annual Acceptance Rate up to year in Mg				Remaining Capacity in m ³	3660229	m ³			
Remaining Capacity Using Initial Design Capacity in Mg		2172155		Mg with 10% settlement	2389370	Mg			
Lifespan Using Initial Design Capacity:	23	Yrs.		Lifespan including standard value of settlement:	25	Yrs.			
Assumptions, Data and Recommendations									
Assumptions:									
Data:									
Information regarding planned additional cells were extracted from the document "Informe sobre el Sistema de Relleno Sanitario de Yauco" dated February 2018 and prepared by Engineering Resources Team, LLC. This Landfill is currently no in operation.									
Recommendations:									
Formulas:									
Lifespan = (Remaining Capacity - Cover) / Average Annual Acceptance Rate									
Mg = m ³ x Density									
Poorly Compacted Standard Density = 1000 lb/cuyd					South located Landfills Standard Settlement = 10%				
Well Compacted Standard Density = 1200 lb/cuyd					Other than South located Landfills Standard Settlement = 15%				

Chapter 5

HYDROLOGICAL RISK FACTORS

The Yauco MSWLF is located over the Juana Diaz Formation that belongs from the middle Miocene to lower Oligocene (US Geological Survey, 2018). The lithology of the area is a Mudstone and basal conglomerate member from the Oligocene. Deposits of sand and gravel and gray to grayish-orange mudstone and sandstone can be found in the area (Krushensky & Monroe, 1979). The southwest side of the island, in the area of the landfill, is a very active seismic zone (Puerto Rico Seismic Network, 1999). The soil type above the facility is named as Landfill (LfC) type with slopes between 0% to 8%. South of the landfill, the soils type is Pitahaya-Limestone Outcrop-Seboruco Complex (PsF) which terrain slopes varies between 40% and 60% and is a well-drained terrain with moderately low to moderately high permeability (0.14 in/hr to 1.42 in/hr). At the north, the soil type is Costa-Pitahaya Complex (CuF) with slopes of 20% to 60% and is a well-drained terrain with moderately low to moderately high permeability between 0.14 in/hr to 1.42 in/hr (Natural Resources Conservation Services, 2018). This information is based on the footprint of the landfill.

The Yauco MSWLF is surrounded by the Karst Restricted Special Planning Area (APE-RC, by its acronym in Spanish) (Planning Board, 2014). This regulation prohibited any physical change to the karst area including excavations, deforestation, among others. Any proposed change of this protected areas need the approval of the Planning Board. These Karst areas are an important region of recharge for the existent aquifers.

The Natural Reserve Bosque Seco de Guánica is located around 0.6 km south of the landfill. This reserve preserves flora and fauna distinctive from the dry forest. The fauna includes 185 birds, some of which are endangered species (Arendt, Faaborg, Canals, & Bauer, 2015). *Ottoschulzia rhodoxylon* (federally endangered plant), *Trichilla triacantha* (federally endangered plant), and the Puerto Rican Crested toad (*Peltophryne lemur*) (federally threatened species) have been identified by the U.S. Fish and Wildlife Service as proximate to the Yauco MSWLF. The proximity of the landfill probably can affect the life of these species. More investigation is needed to know the impact of the landfill to these species.


The landfill facility is located between two principal streams of the area. Loco River is located 2.0 km to the west of the landfill and Yauco River is located 2.5 km at the east. The drainage pattern of the landfill area (see Figure L-1) flows in the direction of the Yauco River and is part of its watershed, which discharges in the Guayanilla Bay. The Yauco River also flows through the Yauco – Guayanilla Valley which is used for agriculture and is part of the alluvial aquifers of the zone.

The facility is located above a minor aquifer which is composed of volcanoclastic, igneous, and sedimentary rocks. The nearest aquifer to the landfill is located at Rio Yauco Valley. This aquifer is an alluvial aquifer which is recharged directly by the Yauco River. Recharge from rain is minimal due to the low infiltration characteristics (previously discussed), high evapotranspiration and low rainfall frequency, intensity and duration (Ramos-Ginés, 1996).

Chapter 6

CONCLUSIONS

According to the assessment performed for this landfill, the following conclusions and findings can be addressed:

1. According to the available data, the remaining capacity of the Yauco MSWLF is 0.00 yd³.
2. The landfill maximum capacity is planned to be expanded up to 4,788,056 yd³ and with a proper compaction procedure this capacity with a 10% of settlement could be reach to 5,266,861 yd³ resulting in a planned lifespan between 23 yrs. to 25 yrs.
3. Slope measurements for the landfill indicate that the slopes angles do not meet the slope stability criteria of 2.5:1.
4. The historical footprint extension of the landfill is illustrated in  Appendix H, Figure H-1.
5. Associated risk factors related to:
 - i. Floodplains – According to the FEMA and the FIRM number 72000C Panel 1615H, revised on April 19, 2005, The Yauco MSWLF floodplain classification is Zone X. This classification represents areas determined to be outside the 0.2% annual chance floodplain. This information is in accordance with the FEMA and the FIRM number 72000C Panel 1980J, revised on April 13, 2018.
 - ii. Wetlands – The Yauco MSWLF is located in an environmentally sensitive area. The property is located within an area inhabited by the Puerto Rico Nightjar. The Natural Reserve Bosque Seco de Guánica is located south of the landfill. This reserve preserves flora and fauna distinctive from the dry forest. The landfill is above freshwater marshes and emergent wetland.
 - iii. Fault areas – Additional geologic study is needed to evaluate the present site conditions. A geologist should inspect the area to determine according to the superficial deposits that no movement has been occurred.
 - iv. Seismic impact zones – Puerto Rico is located in the limit between the plates of North America and the Caribbean. There is evidence of oblique subduction and lateral displacement between the two plates. The seismic activity is concentrated in eight zones: 1. Puerto Rico Trench, 2. Slope faults

in the North and South of Puerto Rico, 3. Northeast of "Zona del Sombrero", 4. To the west, at the Mona Canyon, 5. Mona Passage, 6. To the east, in the depressions of Virgin Islands and Anegada, 7. Muertos Depression to the South, & 8. Southeast of Puerto Rico. As per USGS, randomly horizontal components of peak horizontal acceleration for Puerto Rico and USVI zone could be taken between 25 g and 40 g. For Horizontal spectral response acceleration for 0.2-second period value could be in the range between 50 g to 100 g, and for 1.0- spectral response acceleration between 19 g to 30 g. (USGS Earthquake Hazards Program).

- v. Aquifers/monitoring wells systems/engineering controls – the Yauco MSWLF is below freshwater marshes, emergent wetland, and fissured aquifer. The facility is located above a minor aquifer, which is composed of volcanoclastic, igneous, and sedimentary rocks. The nearest aquifer to the landfill is located in Rio Yauco Valley.

The nearest four wells are located 3.8 km (2.36 miles) northeast of the landfill.

The landfill has four retention ponds for storm water, has no liner, no leachate collection system, and does not have GCCS in place. The landfill has five groundwater monitoring wells in place.

- vi. Drinking water wells – EQB and the Puerto Rico Aqueduct and Sewer Authority (PRASA) do not have potable wells at the property.
- vii. Sensitive ecosystems – The Natural Reserve Bosque Seco de Guánica is located south of the landfill. This reserve preserves flora and fauna distinctive from the dry forest. Also, the site location is surrounded by the Karst Restricted Special Planning Area (APE-RC, by its acronym in Spanish).
- viii. Proximity to housing/schools – The landfill is located at the south region of the island of Puerto Rico, with the nearest residential building located 617.4 meters (0.39 miles) to the west and the Mercedita Airport in Ponce 30.4 km (18.9 miles) to the east. The nearest hospital is Hospital Bella Vista, located

3.2 km (2 miles) north from landfill. The closest school is about 1 km (0.65 miles) west of the landfill.

- ix. Proximity to cultural/historical sites – The Yauco MSWLF is classified under a low archaeological sensitivity. Low classifications designate areas that are not within a known sensitive archaeological area or within/adjacent an area previously subject to archaeological studies with negative results. No residential buildings were identified within 100 m from the footprint of the landfill.

Chapter 7

RECOMMENDATIONS & LIMITATIONS

The following limitations were identified during the development of this landfill capacity assessment:

1. Unavailable documentation, as per Appendix K.
2. The restricted time available for assessment definition, site visit, field work, and final report delivery.
3. Access constraints to the facilities and to obtain documents due to lateness of landfill administration or in charge employee.
4. Delay of documents delivery to the assessment group from the sources that have the information.
5. Lack of information or outdated data in the provided documents.

Chapter 8

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APPENDIX

Appendix A LOCATION MAP

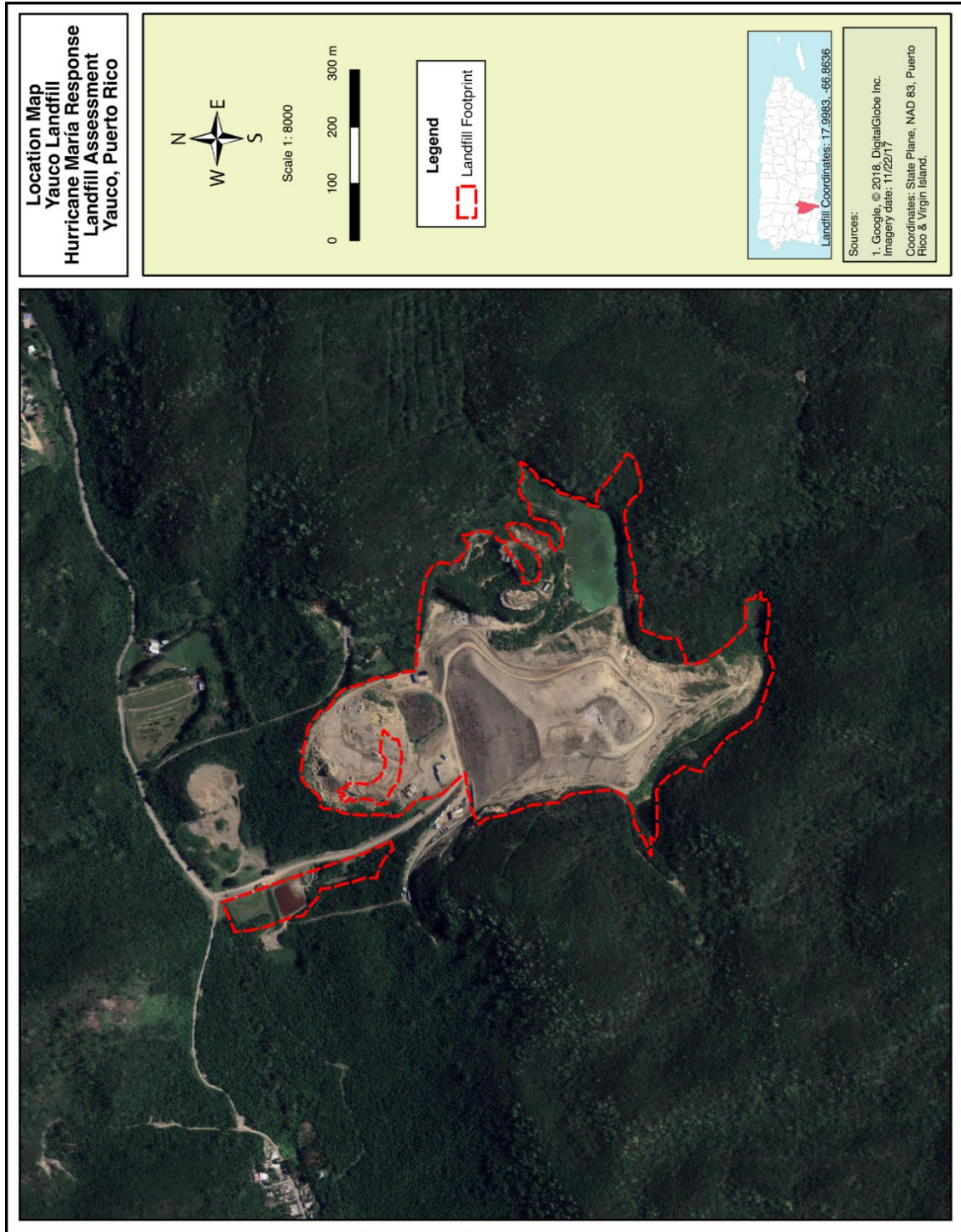


Figure A-1. Yauco Landfill Location Map.

Appendix B GEOLOGICAL MAP

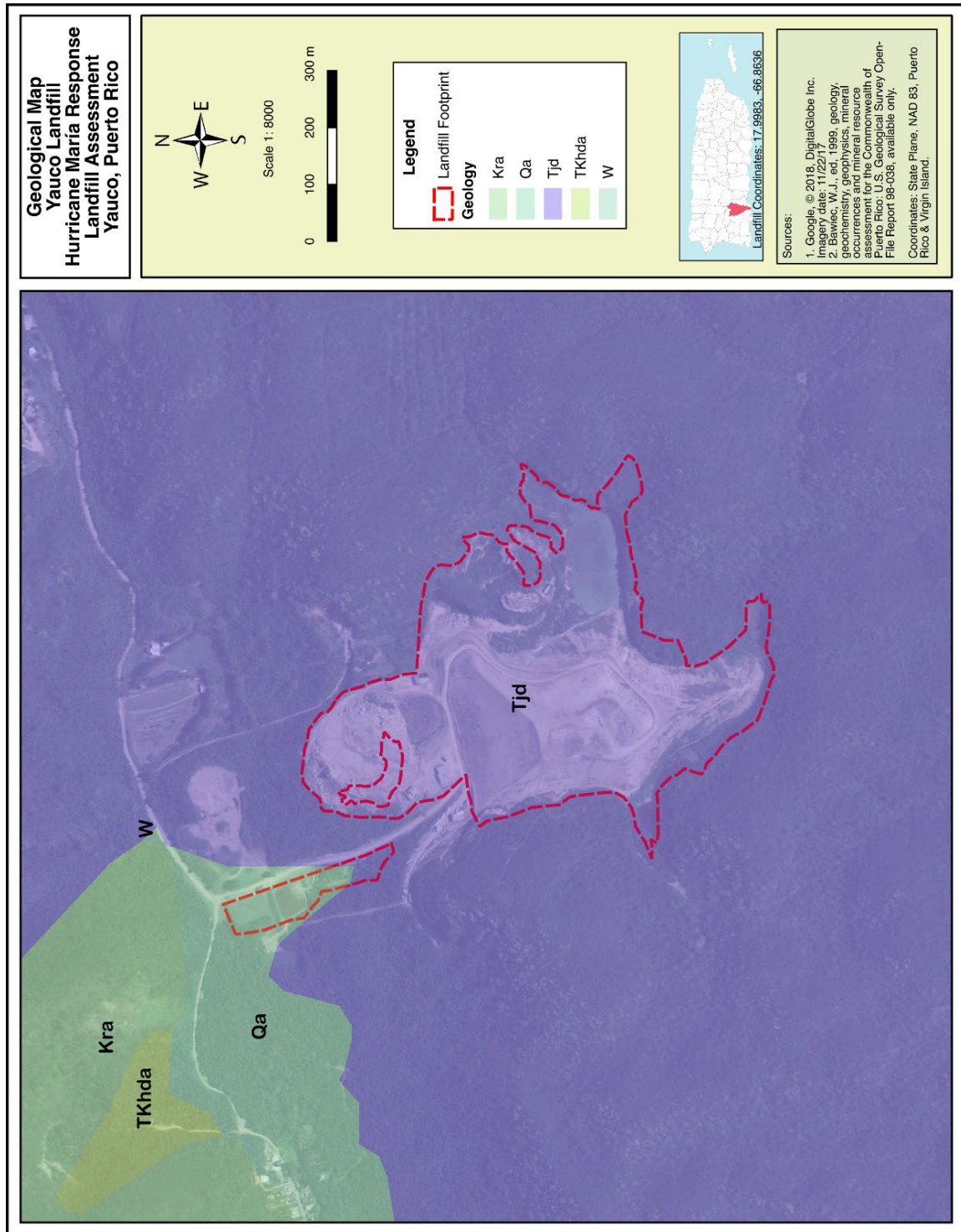


Figure B-1. Yauco Landfill Geological Map.

Appendix C SOILS MAP

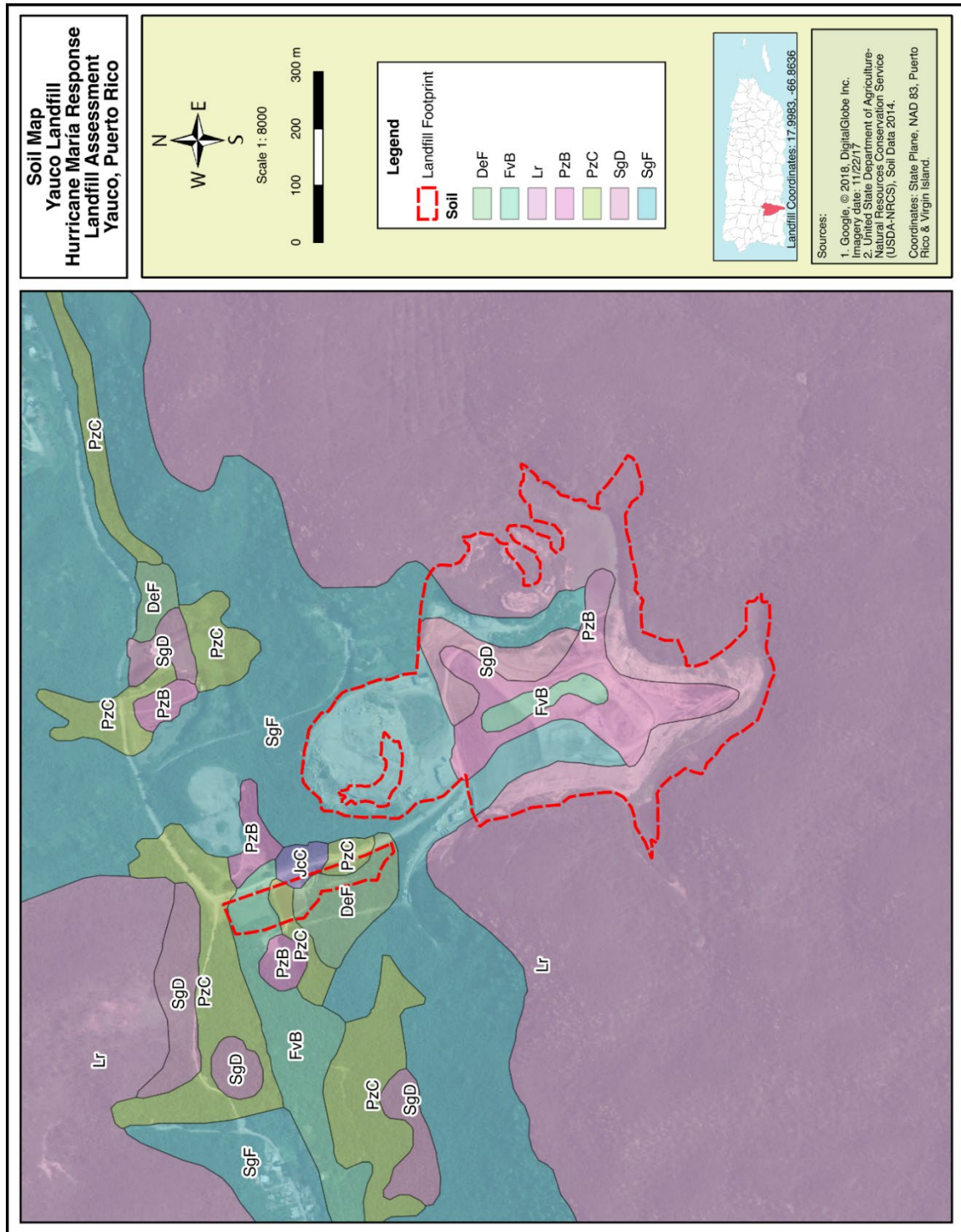


Figure C-1. Yauco Landfill Soil Map.

Appendix D TOPOGRAPHIC MAP

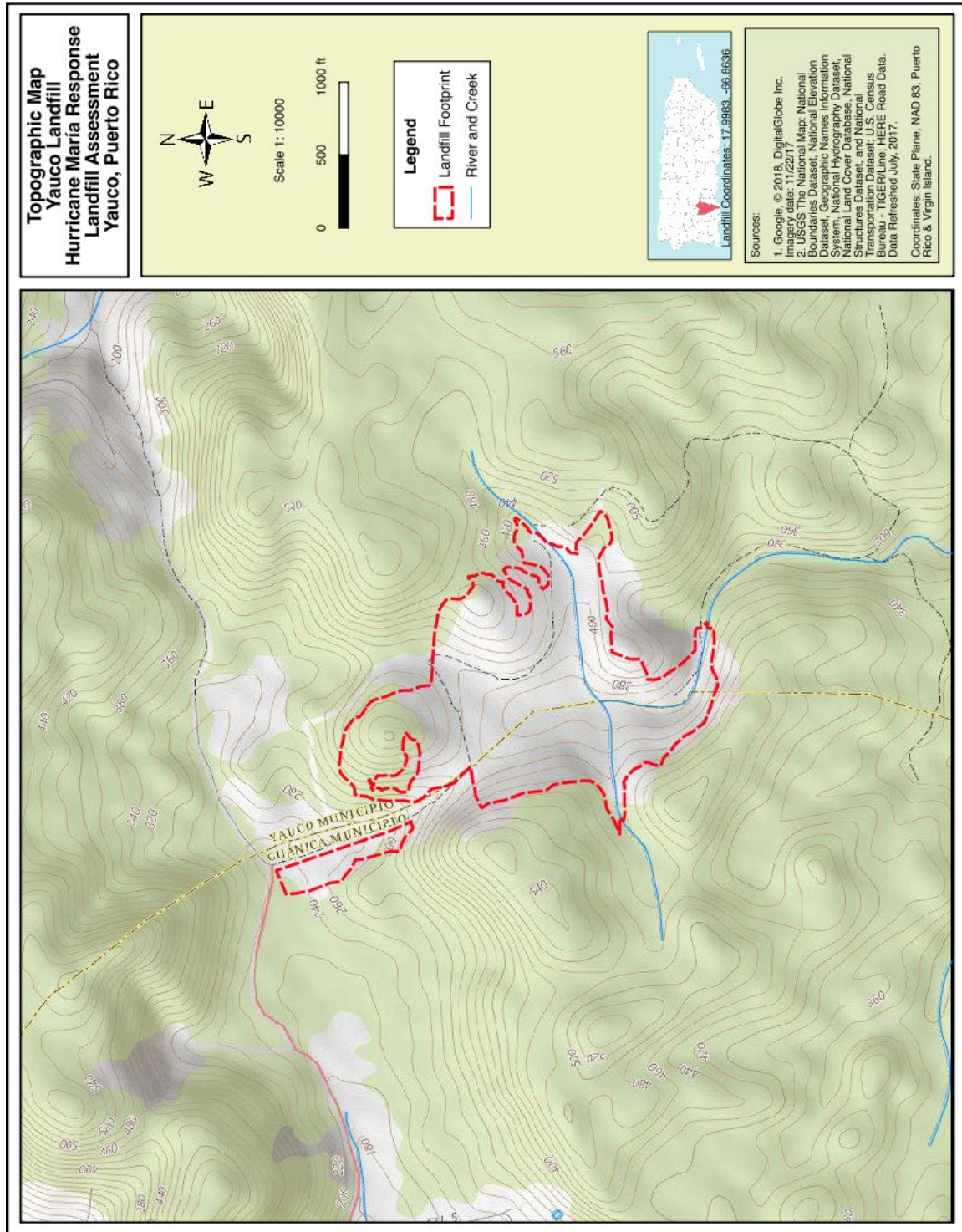


Figure D-1 Yauco Landfill Topographic Map.

Appendix E FEMA FLOODING MAP

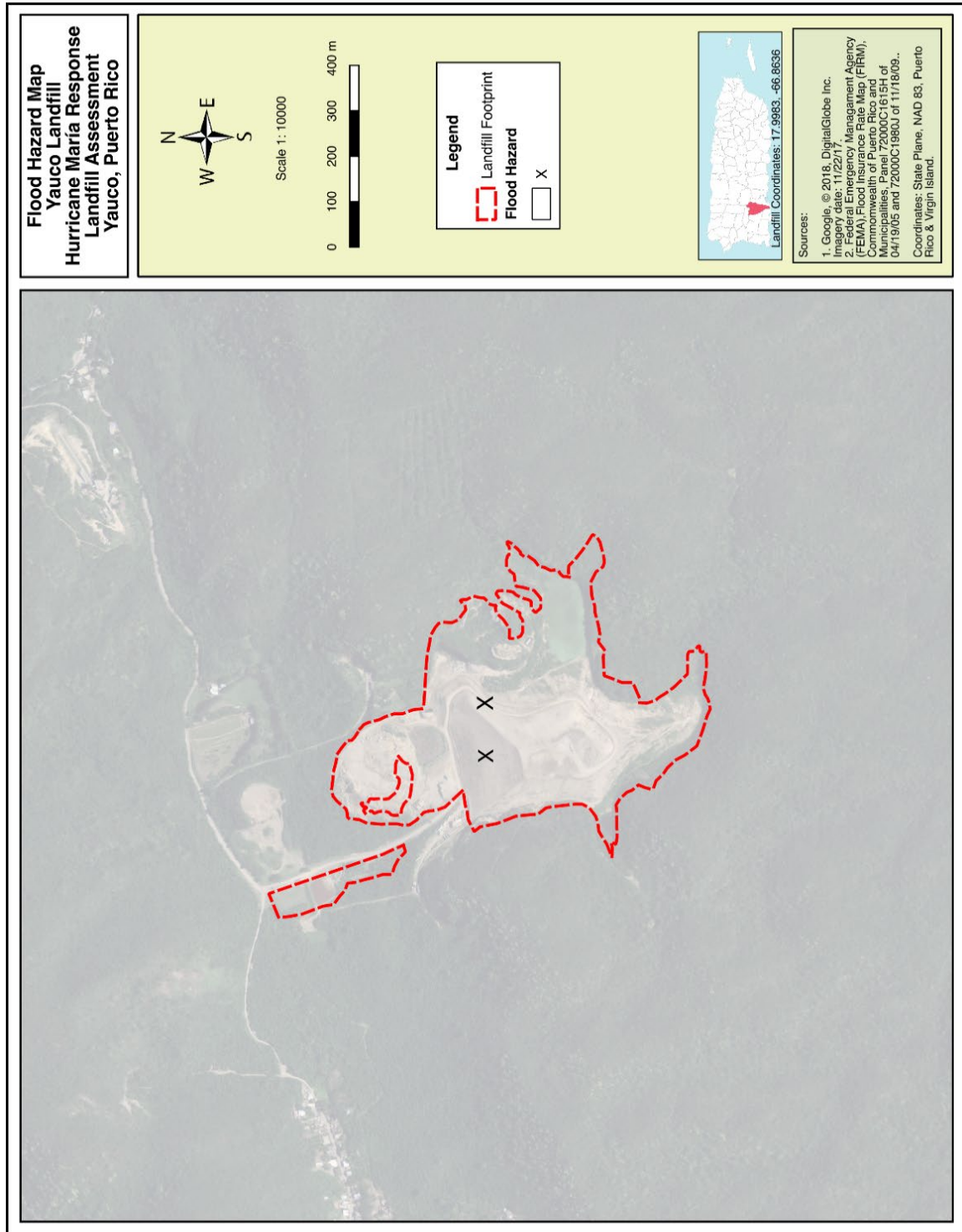


Figure E-1. Yauco Landfill Flood Susceptibility Map.

Appendix F ENVIRONMENTAL SENSITIVITY INDEX MAP

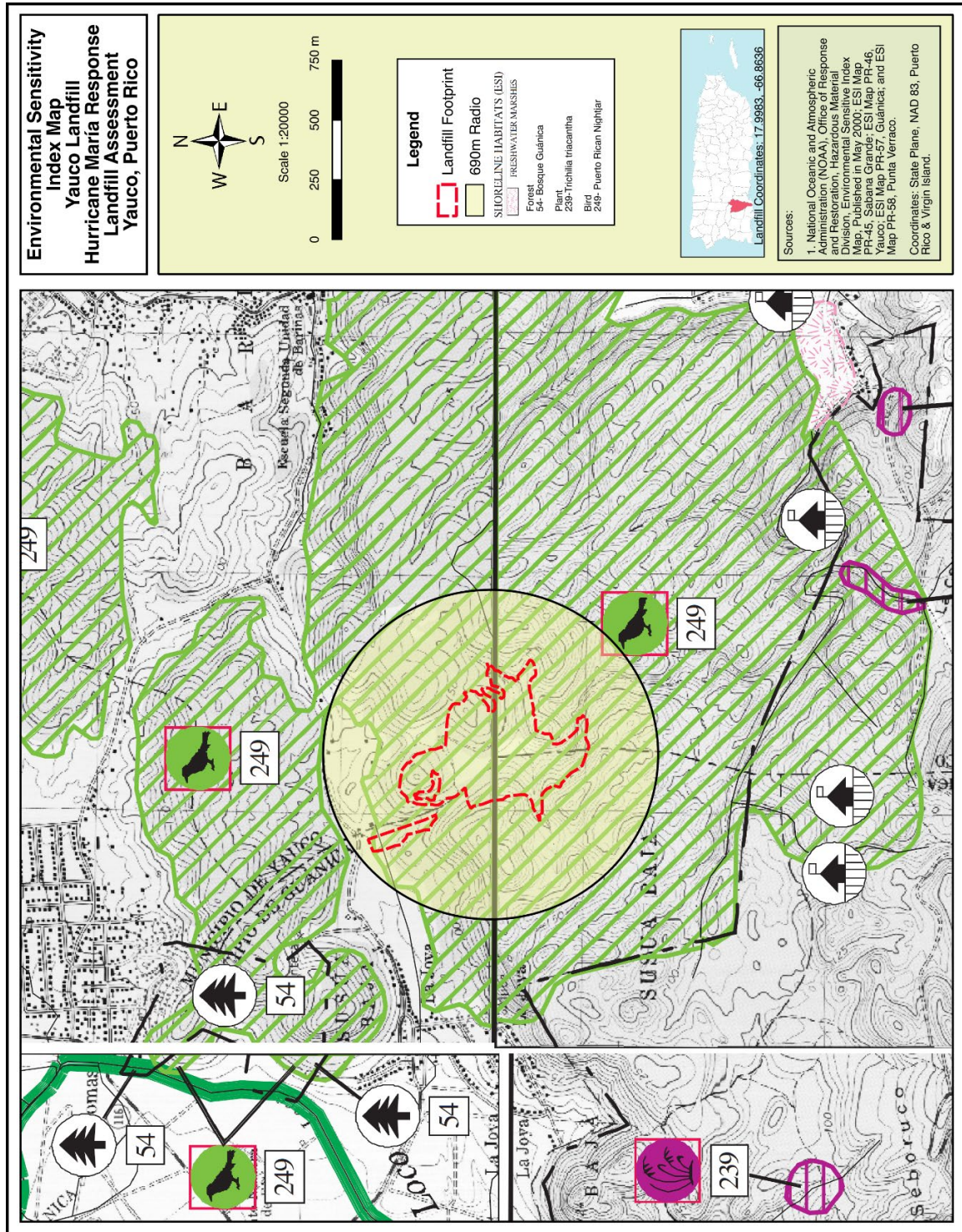


Figure F-1. Yaucó Landfill Environmental Sensitivity Index Map.

Appendix G SURROUNDING POPULATIONS AND STRUCTURE SUSCEPTIBILITY MAP

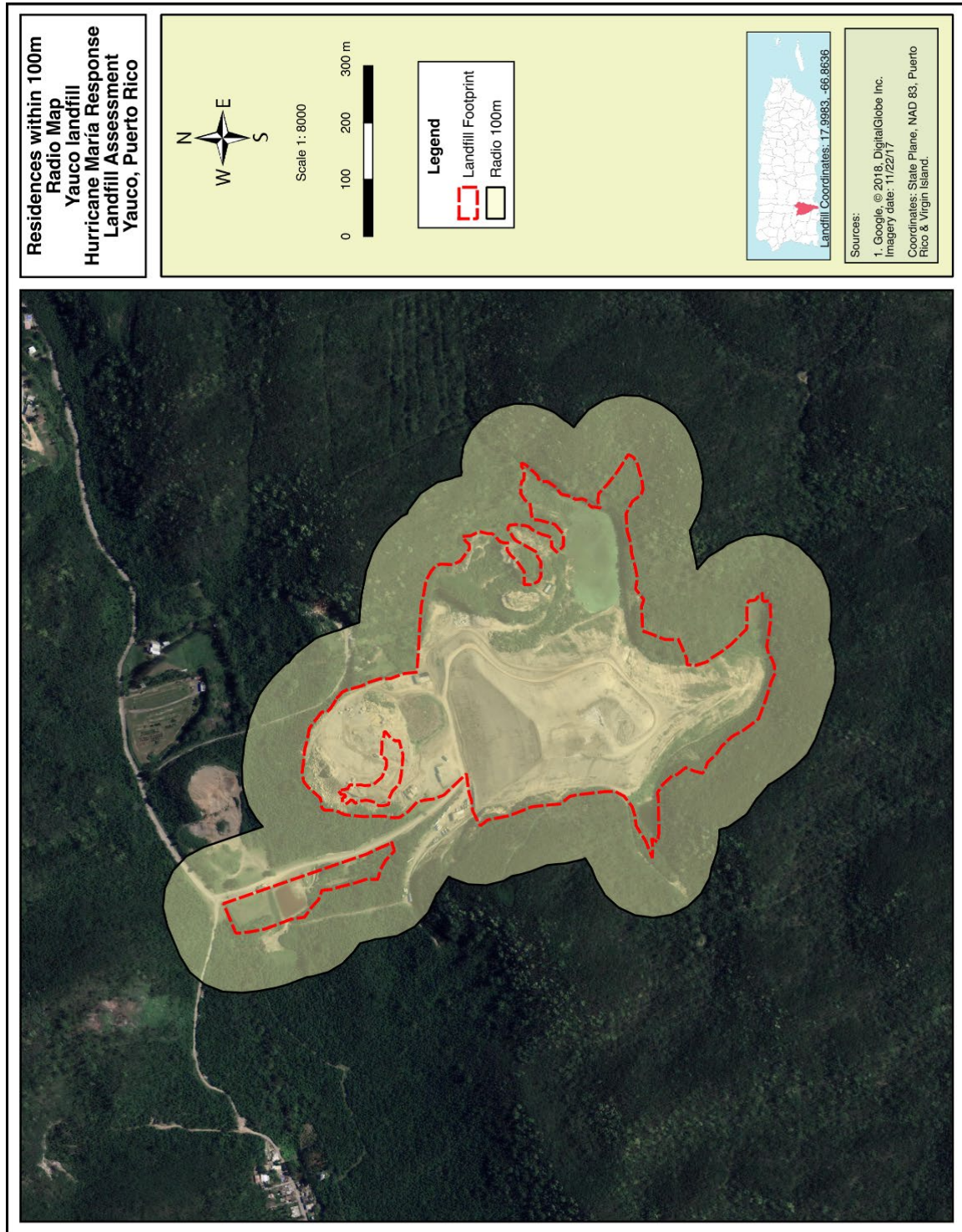


Figure G-1 Yauco Landfill surrounding populations and structure susceptibility maps (100 m radius).

Appendix H LANDFILL FOOTPRINT COMPARISON

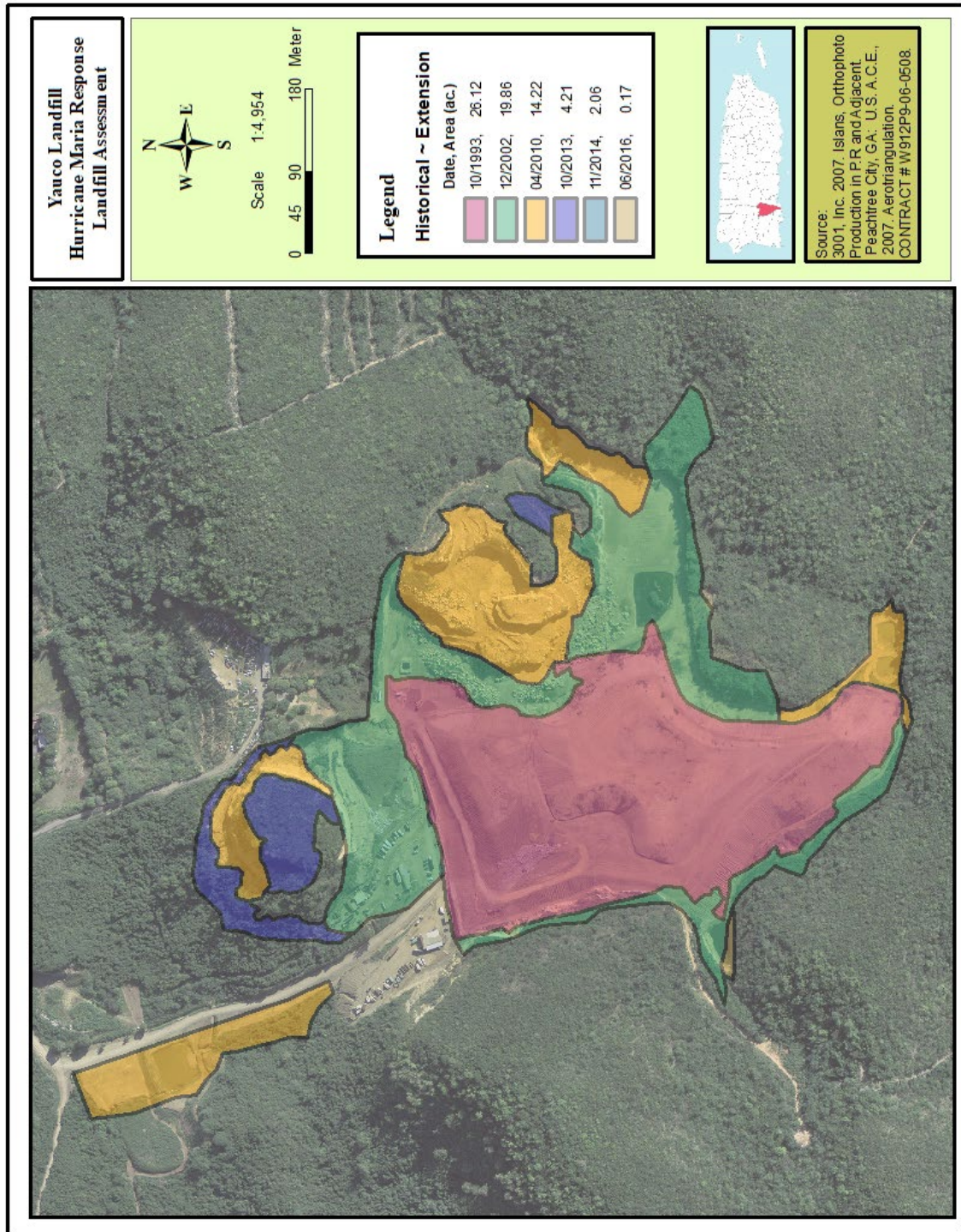


Figure H-1. Yauco Landfill approximate extension from 1993 to 2017.

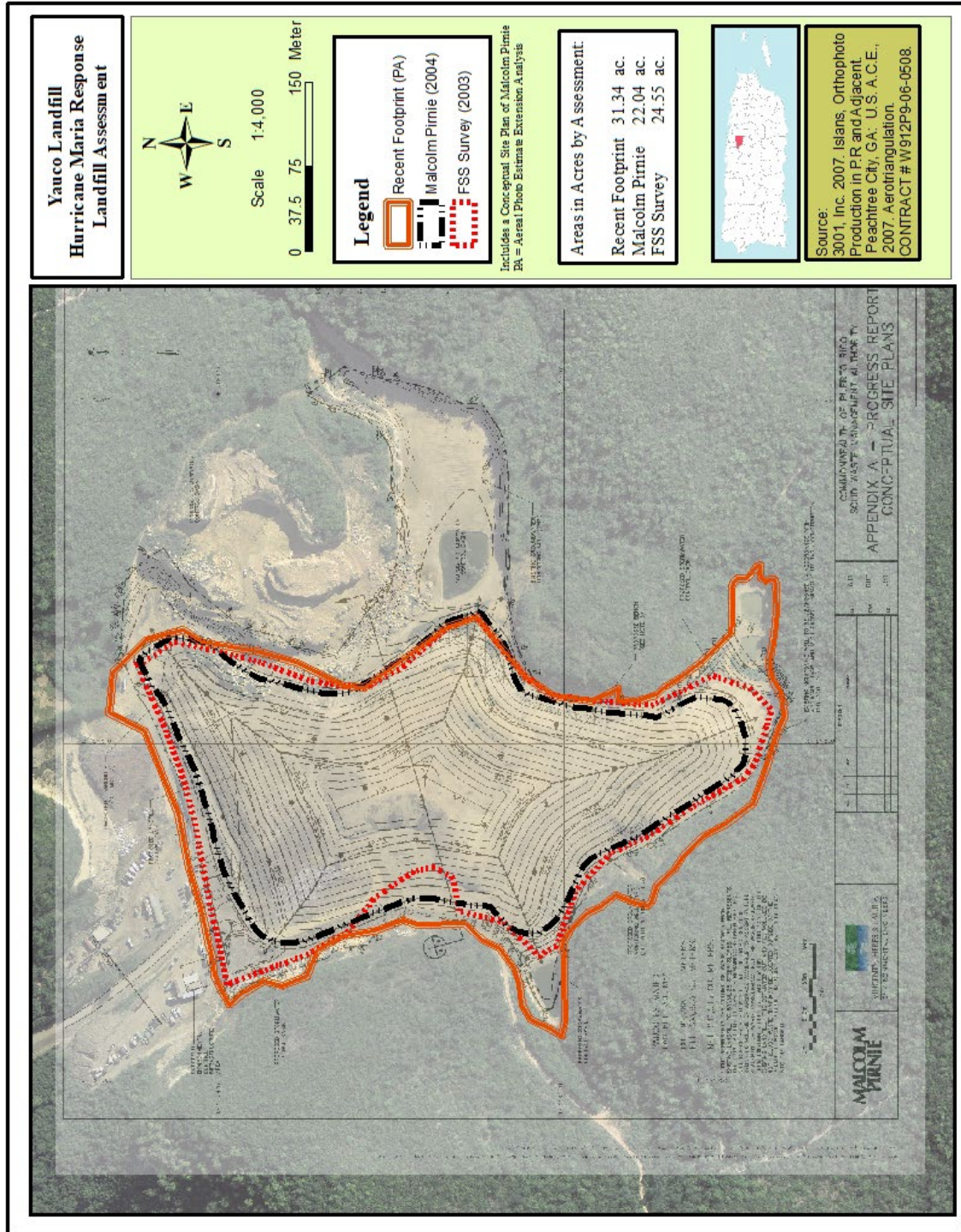


Figure H-2. Yaucó Landfill Footprint Comparison.

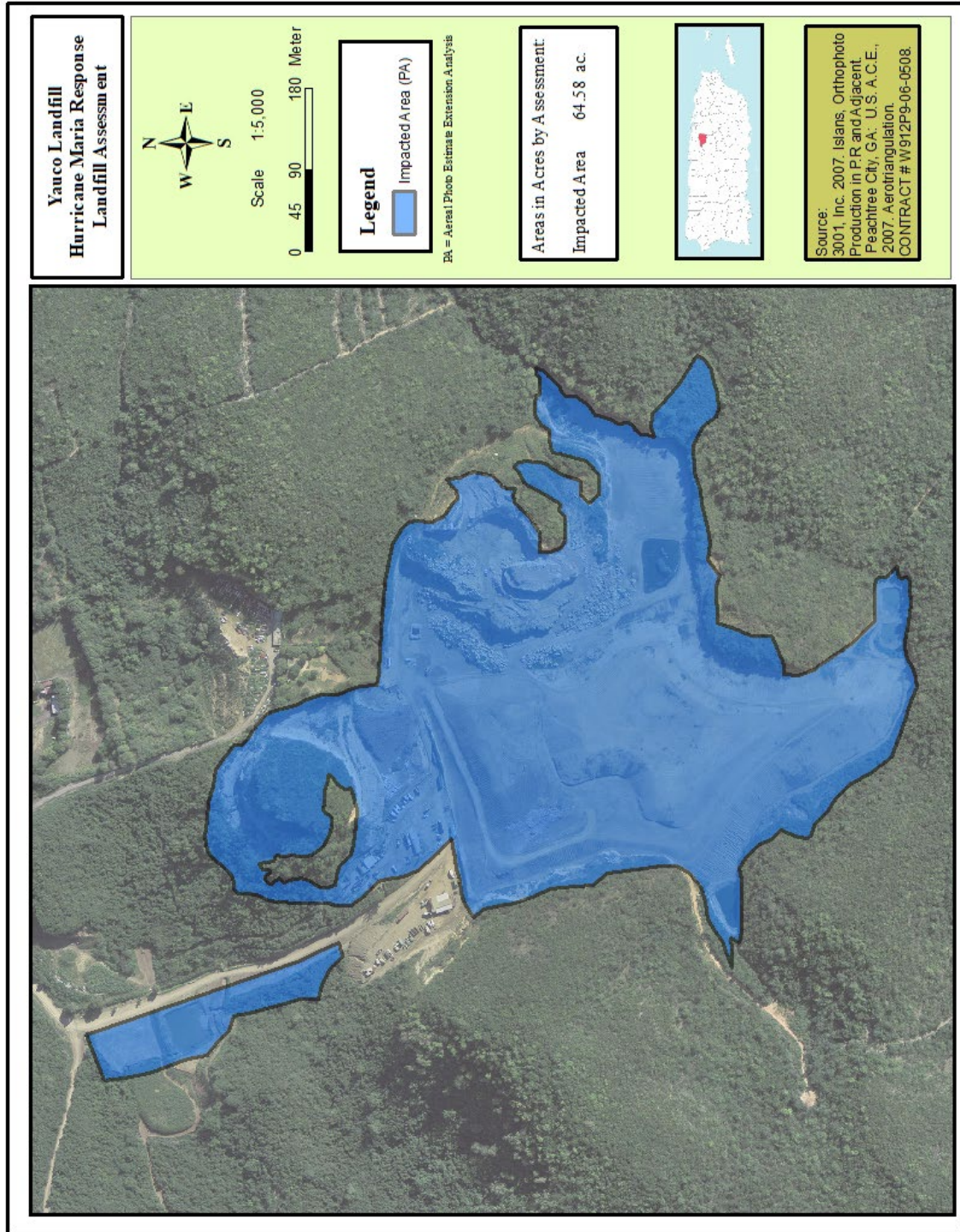


Figure H-3. Yauco Landfill Impacted Area since '90s to 2017.

Appendix I DAILY REPORT

DATE: 04/30/2018

WEATHER: 89° F, Sunny

Location: Yauco Landfill – PR 335 km 3.8, Barina Ward, Yauco, PR

PERSONNEL

WESTON RST

César Cajigas

Xavier Nieves

Raissa Borges

EPA

Alex Rivera

Others

Luis Hernández (EcoPark)

FIELD EVENT: *Preliminary Visit to Yauco Landfill at Yauco, Coordinates X/Y;(17.9983, -66.8636)*

FIELD WORK PERFORMED:

- Crew visited the Yauco Landfill at Yauco, PR and met with Luis Hernández (EcoPark), to obtain information to delineate the assessment needs.
- Crew performed landfill site reconnaissance. It was observed no MSWLF operation happening on the landfill. The landfill is closed due to legal issues. There were no employees no equipment at the landfill. The landfill has approximately 582 ac. of property. The waste extent of the landfill is about 30 ac.
- There is no leachate collection system on the landfill.
- Yauco Landfill is equipped with a groundwater monitoring system.
- Equipment used; PID- MultiRAE Lite. VOC readings 0.0 ppm.

HEALTH & SAFETY:

- PPE Level D.

MISCELLANEOUS:

- Leachate seepages were observed on slopes of the north and west of the landfill.
- Administrative facilities were damaged by Hurricane María.



Figure I-1. Yauco Landfill Site View.



Figure I-2. Yauco Solid Waste and C&D left on the side of the roadway.



Figure I-3. Fuel storage tank and north slope.



Figure I-4. East retention pond.



Figure I-5. East extraction area and a pile of white goods.

Appendix J HORIZONTAL RESPONSE SPECTRAL ACCELERATION

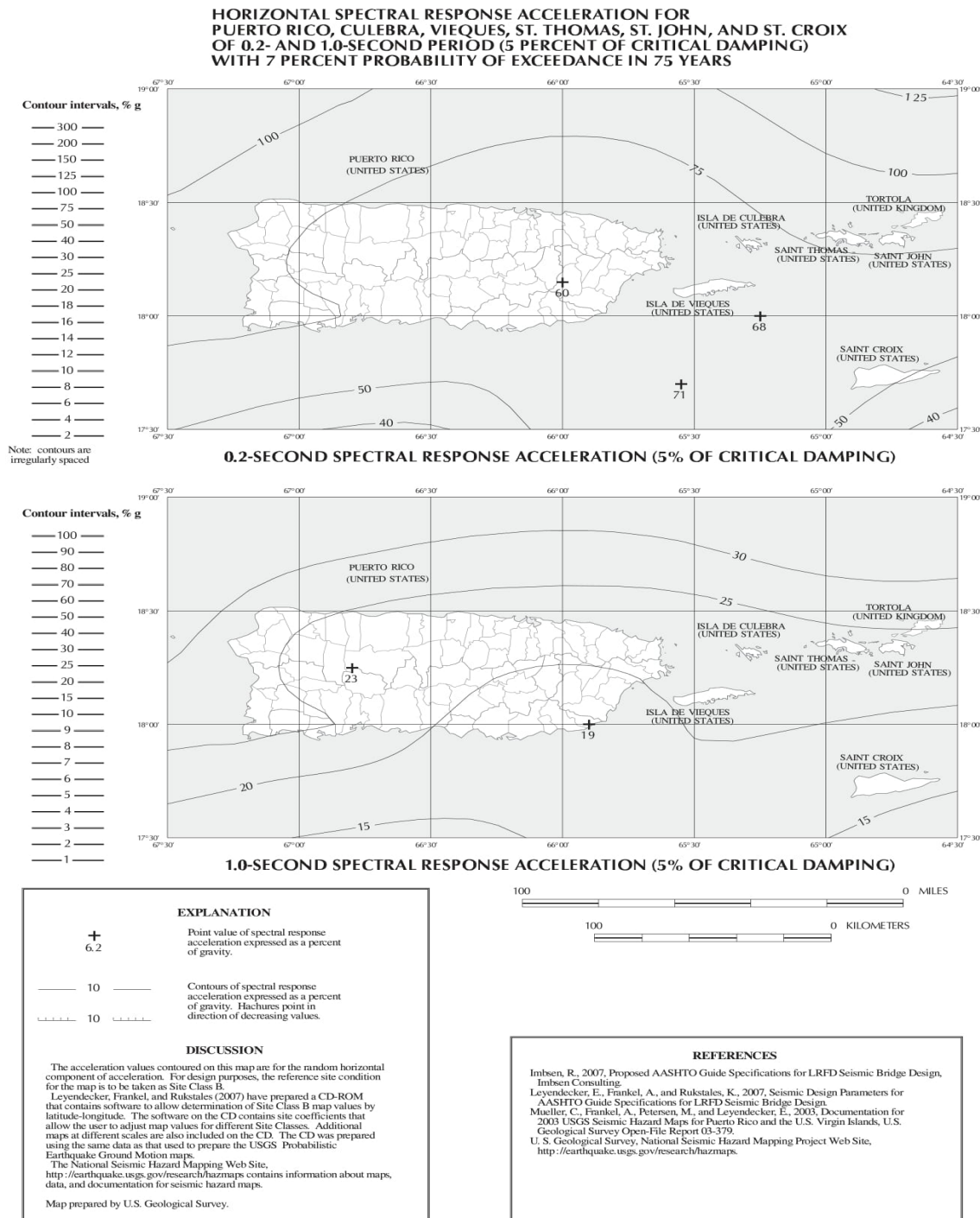


Figure J-1. Horizontal Response Spectral.

**PEAK HORIZONTAL ACCELERATION FOR PUERTO RICO, CULEBRA, VIEQUES,
ST. THOMAS, ST. JOHN, AND ST. CROIX
WITH 7 PERCENT PROBABILITY OF EXCEEDANCE IN 75 YEARS**

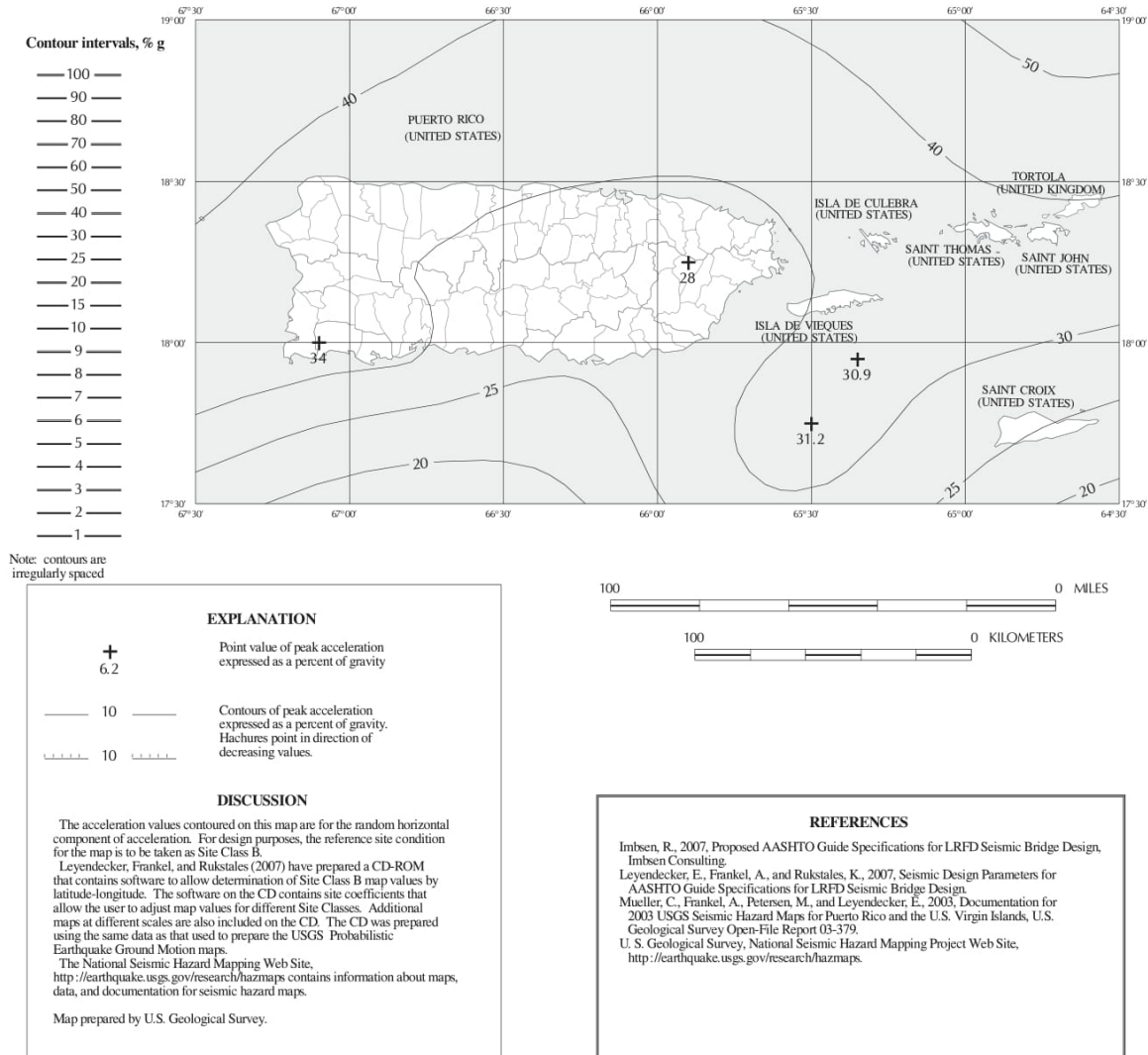


Figure J-2. Horizontal Response Spectral (cont.).

Appendix K UNAVAILABLE DOCUMENTS

Table K-1. Pending Documents.

	Landfill Site / Municipality	Documents	Pending Documents	
1	Añasco	Pending	Solid Waste (Nov-Dec 2016); (Jan-Dec 2017); (Jan- Apr 2018)	
2	Arecibo	Pending	Solid Waste (Jan-June 2016) ; (Jan-Apr 2018)	
3	Arroyo	Pending	Topographic Map, Closure Plan, Operation Plan, Solid Waste (Oct-Dec 2016, Jan-Dec 2017, Apr 16-30, 2018)	
4	Barranquitas	Pending	Solid Waste (August - Dec 2017); (Jan-Apr 2018)	
5	Cabo Rojo	Received		
6	Carolina	Pending	Solid Waste (August - Dec 2017); (Jan-Apr 2018)	
7	Cayey	Received		
8	Culebra	Pending	Operation Permit, Closure Plan, Solid Waste (Jan-Dec 2017); (Jan-Apr 2018)	
9	Fajardo	Pending	Operation Permit, Closure Plan, Solid Waste (Sept-Dec 2017); (Jan-Apr 2018)	
10	Florida	Pending	Operation Permit, Solid Waste (Mar-Dec 2016), (Jan-Dec 2017), (Jan-Apr 2018)	
11	Guayama	Pending	Operation Permit, Closure Plan or Design Capacity Report, Solid Waste (Jan-Dec 2017); (Jan- Apr 2018)	
12	Hormigueros	Pending	Topographic Map, Closure Plan, Operation Plan, Solid Waste (Jan-Dec 2017); (Jan-Apr 2018)	
13	Humacao	Received		
14	Isabela	Pending	Operation Permit, Closure Plan, Solid Waste (Jan-Dec 2016/2017); (Jan-Apr 2018)	
15	Jayuya	Pending	Design Capacity Report or Closure Plan, Solid Waste ((Jan, Feb, Jul 2016); (Jan-Dec 2017); (Jan-Apr 2018))	
16	Juana Díaz	Received		
17	Juncos	Received		
18	Lajas	Pending	Solid Waste ((Oct-Dec 2016); (Jan-Dec 2017); (Jan-Apr 18)	
19	Mayaguez	Pending	Solid Waste (Dec 2016, Apr - May 2017, Jan-Apr 2018)	
20	Moca	Pending	Solid Waste (Dec 2016)	
21	Peñuelas Ecosystems*	Pending	Solid Waste (Jan 2016)	
22	Peñuelas Valley	Received		
23	Ponce	Pending	Topographic Map, Operation Permit, Closure Plan, Solid Waste (Jan-Dec 2017); (Jan-Apr 2018)	
24	Salinas	Pending	Topographic Map, Operation Permit, Closure Plan, Solid Waste (Jan-Dec 2017); (Jan-Apr 2018)	
25	Toa Alta	Pending	Operation Permit, Closure Plan, Solid Waste (Dec 2016; (Sept-Dec 2017); (Jan-Apr 2018))	
26	Toa Baja	Pending	Solid Waste (Dec 2016; Jan-Dec 2017; Jan-Apr 2018)	
28	Vega Baja	Pending	Operation Permit (Request: Nivia Ayala), Solid Waste (Oct-Dec 2016); (Apr 2018)	
27	Vieques	Pending	Design Capacity Report or Closure Plan, Solid Waste (Jan 2016, Apr 2018)	
29	Yauco	Pending	Solid Waste (June-Dec 2016); (Jan-Dec 2017); (Jan-Apr 2018)	
*	Landfill operator sent the information outside of the deadline			

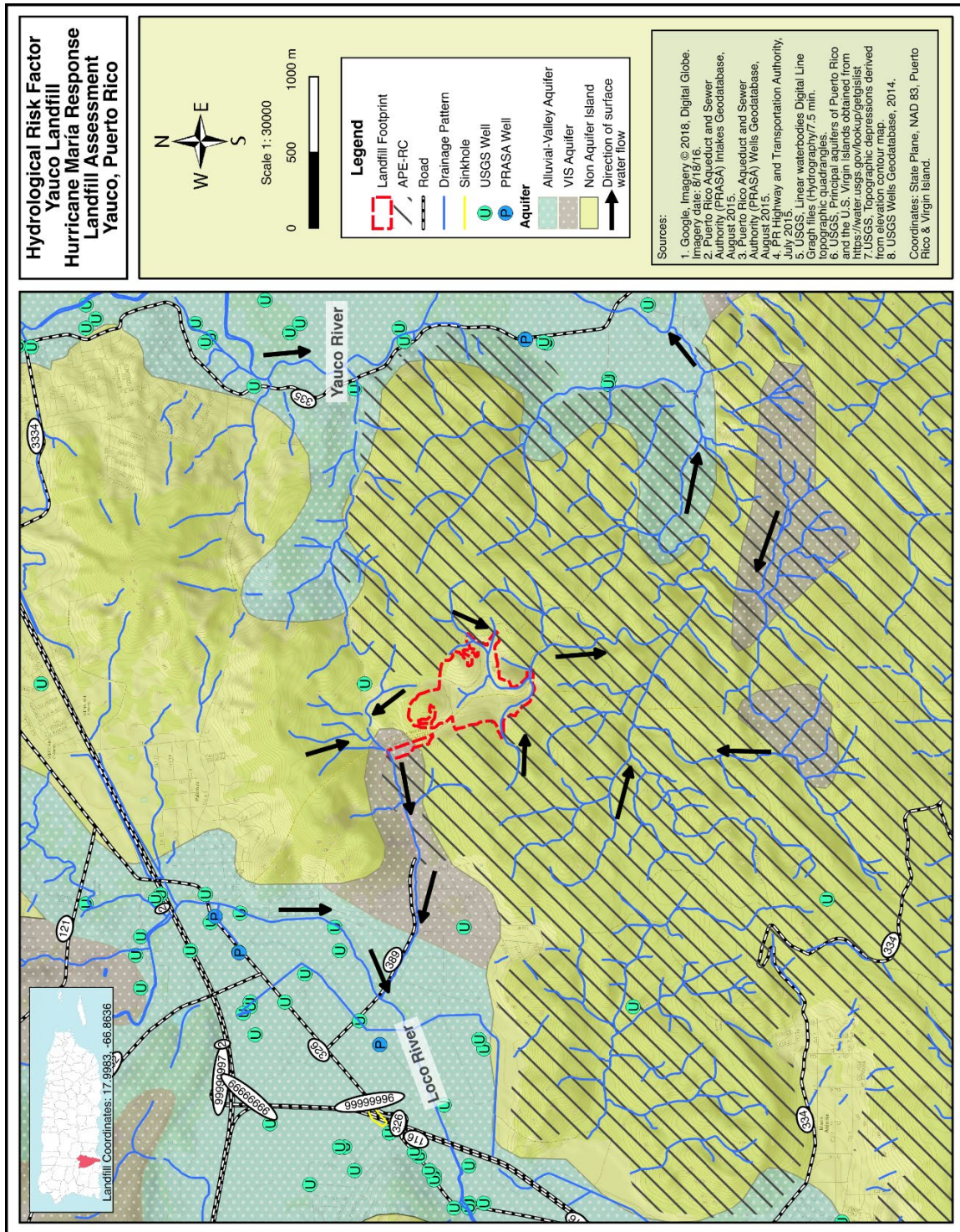


Figure L-1. Yauco Landfill Hydrological Risk Factor Map.

Appendix M **SUPPORTING MATERIAL**

See supporting material file.